

November 2000

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PUBLICATION AZ1187  
11/2000

[ag.arizona.edu/pubs/  
diseases/az1187.pdf](http://ag.arizona.edu/pubs/diseases/az1187.pdf)

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university faculty.

## Pathogen:

Root-knot nematode, *Meloidogyne* species

Nematodes are microscopic round worms found in many habitats. They are the most abundant multicellular organisms on earth. Most are beneficial members of their ecosystems, but a few are economic parasites of plants and animals. There are several plant parasitic nematodes that cause problems on landscape and garden plants in Arizona. The most widespread and economically important are the root-knot nematodes.

## Hosts:

The host range of root-knot nematodes is so extensive that it is difficult to find common landscape and garden plants that are not hosts. Many vegetables, bedding plants, shrubs and trees are susceptible.

## Symptoms/signs:

Infections by root-knot nematode cause decline in the host, and under some conditions, may kill the plant. Infected plants may be stunted and chlorotic, usually wilt easily, and are not productive. However, the extent of damage caused by root-knot nematode infections varies with host, timing of infection, and cultural conditions.

Root-knot nematode infection often is easy to identify because of the swellings in roots that look like "knots." The swellings become large and easy to see on some hosts such as squash, but may be smaller and less conspicuous on others such as chile pepper. Multiple infections on one root result in a swollen, rough appearance. Root-knot nematodes are very small and can only be observed using a microscope.

## Disease:

Unlike free-living nematodes that are numerous in all soils, plant parasitic nematodes must feed on a plant host in order to complete their life cycle. Root-knot nematodes are soilborne and feed on roots. Their life cycle includes egg, juvenile and adult stages. Eggs hatch into juveniles that infect plant roots and take nutrients from the plant as they mature, causing the characteristic knots or swellings to form.

Root-knot nematodes feed by means of a stylet, a retractable mouthpart used for piercing and feeding. Those that enter the root and develop into

females are sedentary, become much enlarged, and lay hundreds of eggs in a sac on the root surface. In moist soils above 80 °F, root-knot nematodes can go from egg to adult in about 25 days.

## Environmental conditions:

Nematodes are most active in warm weather in moist, but well aerated, sandy soils in the presence of host plants. They are most abundant in the upper foot of soils, but will follow roots several feet deep. Root-knot nematodes are not indigenous to soils of the Southwest and are not found in native desert plants unless they have been introduced. In adverse conditions, the eggs can persist in the soil for long periods of time ranging from months to years.

## Prevention/control:

The best way to prevent root-knot nematode is to make sure that only clean materials are introduced into a planting site. Carefully examine all plants before they are planted. When adding soil and/or sand to a planting site, be sure it originated from a site that is not infested. If you are concerned that planting materials may be infested, have a sample analyzed by a professional laboratory or the nematology lab of The University of Arizona (see sampling procedures below). Starting plants directly from true seed also prevents introduction of root-knot nematodes on plant material since they are not seed borne.

## At a Glance

- Root-knot nematode infected plants have swellings on the roots and usually are stunted and unproductive.
- Root-knot nematode has a very wide host range, and once introduced, it is difficult to control.
- Root-knot nematode is most common in warm, moist, sandy soils. Nematodes move in soil on their own, but also are easily introduced into new sites on transplants (which may or may not have visible symptoms), in infested soils, and in soil on tools and other equipment.
- Infested soils can be treated by solarization and amended with compost in the summer to reduce, but not eradicate, root-knot nematodes in the upper foot of soil.

Once soils are infested with root-knot nematode, control is extremely difficult. Summer dry fallow will reduce the nematode populations in soils but will not eradicate them. Soil treatment by solarization also will reduce nematodes. Solarization is a good option for small vegetable gardens and beds if treatments are applied according to recommendations, especially if combined with the addition of large amounts of compost. Soil removal and replacement in infested sites is a short-term option since it is usually

impossible to remove all the nematodes. Avoidance, by planting only winter annuals and using a summer fallow, is an option for heavily infested sites.

Tolerant varieties of some plants are available, but be sure to check their suitability to your environmental conditions. Some non-host and/or tolerant plants include azalea, chrysanthemum, French marigolds, oleander and pine.

## Collecting soil and root samples for analysis

Accurate diagnosis of nematode induced diseases usually requires laboratory analysis for detection and identification. Good samples are the key to accurate identification of plant parasitic nematodes. When collecting samples for analysis, use the following procedures:

1. Take soil samples where young actively growing roots are found. Most plant parasitic nematodes are found around the host roots. Include small roots in the sample.
2. Sample in late spring, summer or early fall when soils are warm since nematodes are most active in warm, moist soils.
3. Take several sub-samples from any one area such as a tree well, small garden or planter using a clean trowel, small shovel or soil corer. Mix sub-samples totaling about a quart in a plastic bag (quart size self-sealing bags work best) and seal the bag.
4. Label the bag with site, host plant, date and your name. Please do not add water, moist paper towels or put papers with sample data inside the bags.
5. Place soil from each sampling site in a separate plastic bag marked accordingly.
6. Protect the sealed bags from temperature extremes – do not allow samples to dry, sit in the sun, or freeze. If necessary, samples can be stored at room temperature up to one week.

Submit samples to your County Agent at The University of Arizona Cooperative Extension office or send them to:

**Extension Plant Pathology  
The Department of Plant Pathology  
The University of Arizona  
Forbes 204  
Tucson, AZ 85721**

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Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, James A. Christenson, Director, Cooperative Extension, College of Agriculture and Life Sciences, The University of Arizona.

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